Review Issues & Discussions from First Workshop

James D. Gilsinn

National Institute of Standards & Technology

Intelligent Systems Division

james.gilsinn@nist.gov

Overview

- The first Wireless Sensing Workshop was held on June 4, 2001, at the Sensors Expo/Conference at the Rosemont Convention Center in Chicago, IL

- The workshop was organized in order to explore industry's interest in wireless sensing.

- 90 people attended the workshop representing:
  - Manufacturing, Process Control, Aerospace, Home Automation, Automotive, and Government

**National Institute of Standards & Technology
Intelligent Systems Division**

Overview (cont'd)

- Overview of IEEE 1451

- Application of IEEE 1451.1

- Review of Current Technologies
  - Wireless Ethernet (IEEE 802.11x)
  - Bluetooth
  - Hardware & Software tools

- Proposed P1451.5 wireless standard

- Open forum & discussion

Proceedings

- Paper Copy of Proceedings
  - Contact Kang Lee, kang.lee@nist.gov
- CD Copy of Proceedings
  - Available here, or
  - Contact James Gilsinn, james.gilsinn@nist.gov
- Web Accessible Copy of Proceedings
  - Available online at http://ieee1451.nist.gov

Why Use Wireless?

- Some attendees questioned whether wireless communications should be used for sensors

- Wireless may not be the best solution for all cases

- Many cases may allow for less deterministic communications. These may present possibilities where wireless is a best-fit solution
  - Large facilities
  - Low-speed, long-range communications
  - Hazardous environments

Data Reliability

- Data reliability was the largest issue raised
- Data reliability depends on:
  - Availability of the wireless signal (hardware)
  - Integrity of the data message (software)
  - Confidentiality of the data message (software)
- Availability
  - Many sensors use ISM band
  - ISM band is free, but full of other users
  - Some standards allow for signal degradation

**National Institute of Standards & Technology
Intelligent Systems Division**

Data Reliability (cont'd)

- Data Integrity and Confidentiality
  - Error checking of data to prevent bad data packets
  - Algorithms available to correct errors in the data
  - IEEE 1451.2 specification for Transducer Electronic Data Sheet (TEDS) has simple error checking
  - Wireless communication lends itself to confidentiality problems
 - Vendors should incorporate additional security features to prevent industrial espionage

**National Institute of Standards & Technology
Intelligent Systems Division**

Bandwidth Requirements

- An informal survey of the bandwidth requirements for workshop attendees was conducted

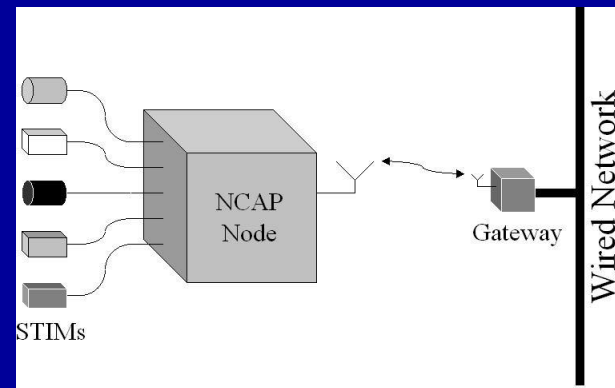 | Bandwidth | Interested Parties |
  | --- | --- |
  | <= 300 bps | 63% |
  | 300 bps - 50 kbps | 25% |
  | 50 kbps - 250 kbps | 3% |
  | 250 kbps - 1.5 Mbps | 6% |
  | > 1.5 Mbps | 3% |

**National Institute of Standards & Technology
Intelligent Systems Division**

Where Should Wireless Be Located?

- The workshop attendees had varying opinions on where wireless communications should be incorporated into a wireless sensor system
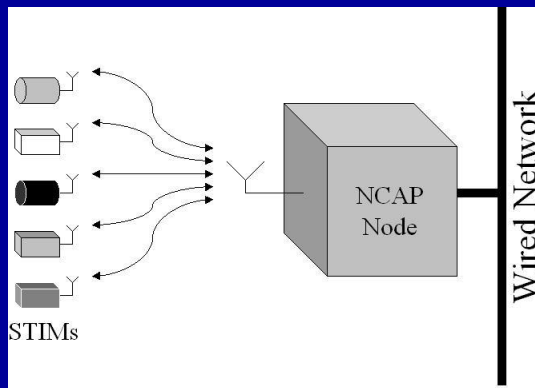
Wireless STIMs

Wireless NCAP Node

Devices Per Node

- NCAP nodes allow multiple sensors to be attached to the network using a common point of access

- An informal survey was taken to determine how many sensors per NCAP node users wanted

  - Sensors/Node   Interested Parties
  - 8   26%
  - 32   53%
  - 256   21%

National Institute of Standards & Technology
Intelligent Systems Division

Transmission Power vs. Battery Lifetime & Safety

- Some wireless communication standards use 100mW of transmission power

- Some sensors expected to run years before replacing batteries

- Batteries lifetime may be reduced because of transmission power

- 100mW transmission power may be too high in hazardous environments

"Hot" Wireless Technology

- Although Bluetooth and 802.11 may not be exactly what sensor vendors want, they may help bring wireless communications to sensors

- Sensor manufacturers and vendors need to consider development cost vs. performance benefits of using standardized technology vs. ASIC chips

- Development systems for some standardized technology may be prohibitively expensive

National Institute of Standards & Technology
Intelligent Systems Division

ISM Band Users

- The Industrial, Scientific, and Medical (ISM) bands setup by the FCC are unlicensed

- Many consumer & commercial devices are designed to use these frequencies

  - 900 MHz   Cell phones, portable phones, home electronics, spread spectrum

  - 2.4 GHz   Portable phones, spread spectrum

  - 5 GHz   Satellite communications

Are Multiple IEEE 1451 Wireless Standards Needed?

- With the seemingly disjoint worlds of low-speed and high-speed wireless communications, is it possible to create one standard that fits the needs of everyone?

- Will multiple versions of an IEEE 1451 wireless standard be needed to account for the varying needs of its users?

Other Issues

- Sensor reconfiguring & reprogramming
  - 2-way links necessary
  - Uplink and downlink can run at different speeds
- Broadcast vs. targeted communications
- High-speed data synchronization by multiple sensors
- Can the NCAP and STIM be combined?

National Institute of Standards & Technology
Intelligent Systems Division

Proceedings

- Paper Copy of Proceedings
  - Contact Kang Lee, kang.lee@nist.gov
- CD Copy of Proceedings
  - Available here, or
  - Contact James Gilsinn, james.gilsinn@nist.gov
- Web Accessible Copy of Proceedings
  - Available online at http://ieee1451.nist.gov

**National Institute of Standards & Technology
Intelligent Systems Division**